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THESIS

**AN ALTERNATIVE INCENTIVE SYSTEM TO IMPROVE
PRODUCTIVITY AT THE TURKISH NAVAL SHIPYARDS**

by

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June 2000

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**AN ALTERNATIVE INCENTIVE SYSTEM TO IMPROVE PRODUCTIVITY AT
THE TURKISH NAVAL SHIPYARDS**

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Lieutenant Junior Grade, Turkish Navy
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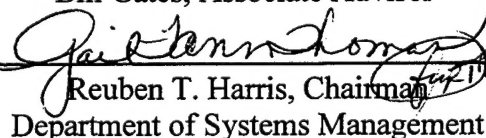
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This thesis researches to identify an alternative incentive system and determine whether it is feasible to implement it at the Turkish Naval Shipyards. The purpose of the incentive system would be to help the shipyards decrease cycle time and total cost, and increase productivity and readiness. This thesis also researches to determine the structural and statutory constraints to the implementation of such an incentive system. The thesis examined the current structure, routine processes, productivity, and compensation system at the Turkish Naval Shipyards. In this thesis, Arena Simulation Software is used to simulate and analyze the current overhaul process within the shipyards. The thesis also examined the alternative incentive systems that can be implemented at the shipyards. This thesis proposes a viable incentive system for the Turkish Naval Shipyards.

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	BACKGROUND.....	1
B.	OBJECTIVES	2
C.	RESEARCH QUESTIONS.....	2
D.	SCOPE AND METHODOLOGY.....	3
E.	ORGANIZATION OF STUDY.....	4
F.	BENEFIT OF STUDY.....	4
II.	CURRENT WORK AND COMPENSATION SYSTEM.....	5
A.	INTRODUCTION.....	5
B.	CURRENT WORK SYSTEM.....	5
1.	Overhaul Maintenance Process	5
2.	Personnel	7
3.	Productivity.....	9
C.	CURRENT COMPENSATION SYSTEM	11
III.	LITERATURE REVIEW OF INCENTIVE SYSTEMS AND INCENTIVES.....	13
A.	INCENTIVE SYSTEMS.....	13
1.	Individual Incentive Systems.....	14
2.	Group Incentive Systems.....	17

3. Organizational Incentive Systems.....	19
B. MONETARY INCENTIVES	20
C. NON-MONETARY INCENTIVES.....	23
D. CHARACTERISTICS OF AN EFFECTIVE INCENTIVE SYSTEM.....	25
IV. DIFFICULTIES IN IMPLEMENTING INCENTIVE SYSTEMS AND A PROPOSED INCENTIVE SYSTEM	27
A. INTRODUCTION.....	27
B. APPLICABILITY OF THE INCENTIVE SYSTEMS	27
1. Culture	28
2. Performance Measurement	31
3. Budget.....	33
4. Laws and Regulations.....	34
C. ORGANIZATIONAL AND INDIVIDUAL GOALS.....	34
D. A PROPOSED INCENTIVE SYSTEM.....	37
V. SIMULATION MODEL.....	43
A. INTRODUCTION.....	43
B. SIMULATION MODEL.....	43
1. Problem Statement.....	43
2. Model.....	44
3. Analysis.....	47
C. POTENTIAL IMPACTS OF AN INCENTIVE SYSTEM.....	55

VI. CONCLUSIONS AND RECOMMENDATIONS	58
A. IDENTIFICATION OF AN ALTERNATIVE INCENTIVE SYSTEM	58
B. INCENTIVE SYSTEM IMPLEMENTATION RECOMMENDATIONS.....	61
C. CONCLUDING COMMENTS.....	62
LIST OF REFERENCES	63
INITIAL DISTRIBUTION LIST	65

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I. INTRODUCTION

A. BACKGROUND

The Turkish Navy has four shipyards employing a wide range of personnel, including officers (managers), military and civilian engineers, and civilian workers. Collectively, these individuals are responsible for building new ships and performing overhaul and intermediate level maintenance. Collectively, the greatest amount of the time and effort is spent for overhaul maintenance at the shipyards. Depending on their type, the ships receive overhaul maintenance every three or four years.

Since the overhaul cycles consume a largest amount of manpower and time at the shipyards, the greatest number of problems occurs at this stage. The primary problem is long cycle time during the overhaul maintenance-- almost none of the ships can receive overhaul maintenance within the scheduled period. Because the cycle time for each ship is very long, the actual overhaul maintenance cost often exceeds the budget. Another significant impact of a long overhaul cycle time is low readiness. Since almost none of the ships complete overhaul maintenance on time, the readiness of the Navy decreases.

To further exacerbate the situation, the productivity and the quality of work at the shipyards are very low, and the shipyard personnel are always behind schedule. One of the most important causes of this low productivity is that there is almost no incentive, to motivate personnel to work efficiently. In this working environment, personnel are reluctant to take responsibility for their work, and appear to take no pride in or ownership their work. The personnel, mostly civilian workers, are typically unaware of or ignorant of the impact of a long cycle time.

B. OBJECTIVES

The objective of this thesis is to determine the feasibility of implementing an incentive system to help increase productivity and readiness, and decrease cycle time and cost under certain constraints.

C. RESEARCH QUESTIONS

1. Primary Research Question

How will the Turkish Naval Shipyards manage the implementation of an alternative incentive system within their existing structures?

2. Secondary Research Questions

- a. What is the current level of productivity at the Turkish Naval Shipyards?
- b. What are the major existing problems at the Turkish Naval Shipyards?
- c. What compensation system is currently being used?
- d. What alternative incentive systems are feasible to implement at the Turkish Naval Shipyards?
- e. What are the constraints of the alternative incentive systems within the context of the existing work structure?
- f. What are the potential impacts of alternative incentive systems on quality and productivity?

D. SCOPE AND METHODOLOGY

The scope of research will be limited to examining existing compensation and work systems, with a subsequent analysis of and recommendation for alternative incentive systems and their implementation.

The data for this thesis were collected via e-mails and phone calls from the Turkish Navy Headquarters and Turkish Naval Shipyards.

The methodology used in this thesis research will consist of the following steps:

1. Conduct a literature review of books, magazine articles, and other library resources.
2. Conduct a through review of the current structure and routine overhaul maintenance processes.
3. Examine the current level of productivity.
4. Review the current compensation system.
5. Review alternative incentive systems.
6. Determine constraints for alternative incentive systems.
7. Build a simulation model using Arena simulation software.
8. Evaluate the potential impacts of a new incentive system on productivity.
9. Recommend a proposed incentive system.

E. ORGANIZATION OF STUDY

Chapter II reviews the current work system and compensation structure at the Turkish Naval Shipyards. The current productivity and the existing problems are also defined in this chapter.

Chapter III reviews alternative incentive systems and discusses their disadvantages and advantages. This chapter also discusses potential impacts on quality and productivity of these alternative incentive systems.

Chapter IV discusses the applicability of alternative incentive systems to a government organization. The chapter examines the structural and statutory constraints of the alternative incentive systems.

Chapter V builds a simulation model of the overhaul maintenance process using Arena simulation software. Chapter V also includes the results of the simulation model, which is used to review potential impacts of an incentive system at the Turkish Naval Shipyards.

Chapter VI recommends an incentive system for implementation at the Turkish Naval Shipyards. Chapter VI summarizes the findings of the previous chapters, answers the research questions, and provides implementation recommendations.

F. BENEFIT OF STUDY

This study will provide the information required to determine if a new incentive system could improve productivity at the Turkish Naval Shipyards. The results of this study can also be used as a model for other Turkish Naval organizations seeking to implement an incentive system to improve their current productivity.

II. CURRENT WORK AND COMPENSATION SYSTEM

A. INTRODUCTION

This chapter provides an overview of the current work and compensation system in place at Turkish Naval Shipyards. It also examines the levels of productivity and existing problems with the current levels of productivity and the compensation system at the shipyards.

B. CURRENT WORK SYSTEM

The mission of the Turkish Naval Shipyards is to provide affordable, timely, and quality maintenance, to build new ships, to modernize existing Naval ships, to deactivate old Naval ships, and perform emergency repairs on Naval ships.

Overhaul maintenance is the most critical, ongoing mission of the shipyards as this process is periodically applied to all of the ships in the Turkish Navy. Since overhaul maintenance consumes the greatest amount of time, money, and effort of all the tasks conducted at the shipyards, its effect on the productivity of the shipyards is the most significant. Therefore, the overhaul maintenance process will be reviewed to examine current productivity.

1. Overhaul Maintenance Process

Every ship in the Turkish Navy receives overhaul maintenance every three or four years, depending on the type of ship. Ships can be categorized as small, medium, and large. The overhaul process is the same for each type, only the overhaul period changes

according to ship type. The overhaul maintenance steps start even before the ship enters the shipyard and end when the ship becomes operational after the overhaul. Figure 1 shows the steps before/during/after the overhaul process for any type of ship.

1. Ship requisitions maintenance
2. Shipyard performs first inspection
3. Ship makes appropriate changes to requisitions
4. Shipyard performs second inspection
5. Overhaul maintenance process begins
6. Last inspection is conducted prior to the end of overhaul
7. Overhaul maintenance process ends
8. Refresher training for the ship
9. Ship becomes operational available.

Figure 1. Overhaul Maintenance Steps

Extensive details for each step listed above are listed in various Naval maintenance documents. These documents also give a timeline for each step indicating how long each step should take. The shipyard personnel make a schedule according to these documents before a ship enters the shipyard; both arrival and departure times of each ship are determined prior to beginning the overhaul process. (An overhaul process is supposed to take 10 months for large ships, eight months for medium ships, and six

months for small ships) During the overhaul process, both ship and shipyard personnel must follow this schedule without any delay.

Within the shipyard, there is a facility for each specific job wherein all tasks are carried out simultaneously and/or sequentially. These facilities are listed below in Figure 2. Each facility's process time is given and used in building the simulation model in Chapter V.

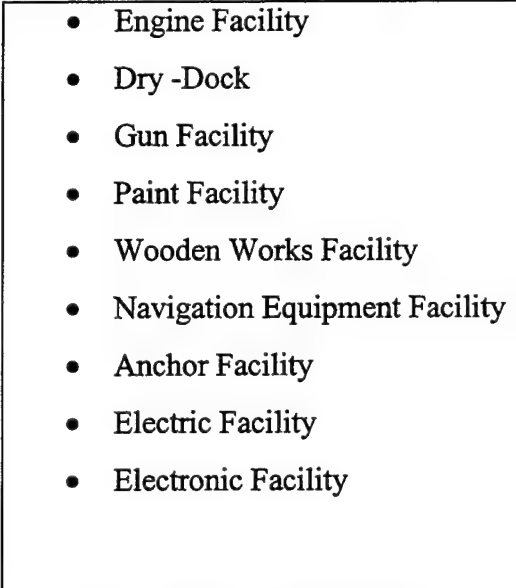
- 
- Engine Facility
 - Dry -Dock
 - Gun Facility
 - Paint Facility
 - Wooden Works Facility
 - Navigation Equipment Facility
 - Anchor Facility
 - Electric Facility
 - Electronic Facility

Figure 2. Facilities

2. Personnel

The shipyards are the only military organization in the Turkish Navy in which military personnel work with a number of civilian personnel. The majority of the employees in the shipyards are civilian workers. The number of personnel in each shipyard is slightly different. Figure 3 shows the average number of personnel in each shipyard.

Military Personnel		Civilian Personnel	
Officers/Non-com. Of.	98	Engineers	25
Engineers	31	Workers	955
Total	194	Total	980

Figure 3. Average Personnel Numbers in Each Shipyard

As previously mentioned, there are 12 different facilities within the shipyards. Within each facility, there is one officer, or *facility head*, who is responsible for every activity and all personnel within that facility. There is also one officer for each ship type who schedules the maintenance procedures performed on the ship. Some facilities have non-commissioned officers who work as experts. Other officers and non-commissioned officers work at the shipyard headquarters. Military and civilian engineers work together at the ship design department. Civilians work as groups at the facilities according to their expertise. For example, the engine facility has almost 150 civilian workers. Within the engine facility, these workers form four different groups; removal, repair, check, and installation. Each facility has a supervisor chosen by shipyard management from the senior civilian workers. These workers supervise the repair work being done within their facilities.

There is seniority among civilian workers as well as among military personnel. Within the current work system, there is a rigid, hierarchical relationship among employees. During the overhaul maintenance process, all procedures must be accomplished by following orders from the shipyard's existing chain of command. Ships are also within this chain of command during the overhaul process.

During the overhaul process, the involvement of ship personnel is very limited. Most of the time, the ship's personnel address administrative issues and perform routine activities within the ship. The ship's personnel, as end users, can only advise on routine maintenance issues

3. Productivity

The productivity of the shipyard depends on the productivity of each facility or department. Each facility's specialized function can be considered as part of a chain reaction for a ship during overhaul maintenance. Some of the facilities cannot start specific jobs on the ship until the other facilities finish. For example, an engine facility must wait until the pipe facility removes a pipe connection with the engine. During overhaul maintenance, any delay in any facility affects the entire cycle time for a ship. Even a short delay in a facility at the beginning of the overhaul process may become a significant problem, because that short delay will snowball into longer delays as the maintenance process continues.

In order for a ship to become "operationally available" after overhaul maintenance, all facilities must finish their maintenance procedures on the ship. The most critical factor in determining the shipyard's productivity is whether or not an overhaul maintenance process for a ship is finished on schedule. Figure 4 provides the overall impression of the shipyards' productivity by examining data from the last ten years. (In Chapter V, the current productivity will be analyzed by building a simulation model.)

Year	# of arrivals	# of departureess as scheduled	Percentage
1990	17	7	.41
1991	13	6	.61
1992	18	10	.55
1993	12	5	.41
1994	14	7	.50
1995	14	8	.57
1996	15	7	.46
1997	14	9	.64
1998	19	12	.63
1999	16	8	.50
AVG	15	7.9	.52

Figure 4. Productivity Ratios

The second column in the above figure shows the total number of all ships arriving at the shipyards for overhaul maintenance. The third column shows the number of ships that received the overhaul maintenance within the scheduled period. The ratio column represents the shipyards' level of productivity that is expressed in terms of the percentage of the overhauls on schedule. For the last ten years, the average level of productivity has been slightly over fifty percent; this very low ratio is a factor that decreases the readiness of the entire Navy. One out of every two ships cannot depart on time from the shipyard after the overhaul process, which means that almost half of the Naval ships cannot become operational at any time.

C. CURRENT COMPENSATION SYSTEM

Shipyards implement their compensation system following the regulations and specifications outlined in the Navy Award Program. This award program addresses types of awards, including which situation and to whom they should be given for all Naval organizations. The purpose of this program is to improve Naval operations by increasing productivity, and to recognize and motivate employees by bestowing performance and incentive awards.

Within the shipyards, the existing compensation system has the following awards and incentives:

- Early Promotion (officers only)
- Performance Awards
- Special Act Award
- Navy-Wide Honorary Awards
- Invention Award

Early promotion awards are available only for the officers who are in the last year of Lieutenant rank. Within the entire Navy, the maximum number of officers getting this award cannot exceed five. Every year, the records of the officers that are in their 14th service year are reviewed, and the top five are selected by Navy Headquarters. Then, these five officers get promoted one year earlier than their scheduled promotions.

Performance awards are given to the employees that perform better than others. Special act awards are given to the employees that make an extraordinary contribution to their organizations. Honorary awards are used to recognize an employee's overall value

to the organization. Invention awards are available for the employees who invent something useful that was not invented before. All these awards mentioned in this paragraph take the form of recognition.

The current compensation system is very limited. The reality is that the awards listed above exist primarily in names. Some of them are virtually impossible to get, and others are superficially implemented. For example, it is extremely difficult for an officer to get promoted before the standard number of years of service, because of the limitations of this award mentioned above. Therefore, this promotion incentive is an unrealistic goal for most of the officers, and this incentive has no effect in increasing productivity. Another example is that the "*Employee of the Month*" award, given as a performance award. This award should be given according to employee performance, but in reality, it is given according to the employee's turn. Under these circumstances, every employee knows that he will be given the award, and when. In summary, it appears that there is little evidence to support the success of the current incentive system. No specific strategy currently exists that appears to motivate or enhance employee productivity.

III. LITERATURE REVIEW OF INCENTIVE SYSTEMS AND INCENTIVES

A. INCENTIVE SYSTEMS

The word "incentive" comes from Latin, *incentiuus*, that means, "setting the tune." An incentive is something that influences people to act in certain ways. An *incentive system* is a collection of incentives and a set of procedures for using them. Organizations use incentive systems to motivate their employees to work more efficiently and to maximize the employee's potential. The use of incentives by business organizations to encourage workers and reward excellence is becoming increasingly popular. Incentive compensation can take the form of non-monetary or monetary incentives. This chapter focuses on the use of both monetary and non-monetary incentives.

In today's environment, it is becoming harder to find the talent needed for a company to be effective and efficient. From a performance perspective, the ultimate objective should be to create a workplace environment that is filled with rewards and recognition to achieve results that make a difference in productivity. In striving to create such an environment, re-evaluating incentive systems becomes very important. In order to stay on the cutting edge of progress and productivity, organizations have to re-think standard incentive systems and try to envision the incentive system as a product--a product for the internal customer, the employee.

The objective of incentive systems is improving individual and organizational performance. An employee who meets performance expectations is eligible for recognition through an incentive system that includes monetary awards, bonuses and/or

non-monetary awards. Incentives can be used strategically to encourage achieving specific productivity, performance, and production goals. Eighty nine percent of American workers think their organizations would perform better if employees were given meaningful incentives to improve quality and productivity. (Nelson, 1996)

In the past, many incentive systems were developed and implemented based on environmental conditions, organizational and individual goals and needs. Currently, there are a wide variety of incentive systems in use. These incentive systems vary by design and fall into three main categories: (1) organizational incentives, (2) group incentives, and (3) individual incentives. There are monetary and non-monetary incentives within each of these categories.

1. Individual Incentive Systems

Incentive systems focus on either individuals or groups. Individual incentive systems try to reward individual performance. Individual incentives set performance objectives for specific jobs and reward the achievement of the goals. Individual incentive plans fall into three broad categories, depending on the type of employees included and the measurement criteria used: *piecework plans* that reward output in excess of a standard; *multiple individual criteria plans*, which include both quantitatively measurable and qualitatively evaluated performance; and plans with both organizational standards and individual goals. (Peck and Parkinson, 1995).

Individual incentive plans should have strategic objectives such as productivity, cultural, and compensation objectives. Productivity objectives involve achieving measurable specific goals, greater customer satisfaction, and improved quality of the

product or service. Cultural objectives are related to the personality of the organization rather than a concrete outcome, and are thus the least often mentioned. Compensation objectives include goals such as reducing compensation costs by transitioning from fixed to variable wages and salaries that are closely linked to employee performance. These objectives are not directly included into performance criteria the way, for example, productivity objectives are. Rather, they are often a result of the effective functioning of the incentive plan.

There has recently been some decline in the use of individual incentive plans because of the trend to adopt group plans. One such area is information processing by administrative, clerical, and technical employees, since performance measures for these operations are becoming more common. (Peck and Parkinson, 1995).

One of the greatest benefits of individual incentive plans is that an employer can reward superior performance without having to increase base salary or change the amount contributed by the organization to benefit plans. The individual award must be “re-earned” every year, unlike base pay increases that are permanent.

Figure 5 below lists the pros and cons to individual incentive plans. The left hand side of the figure indicates the potential benefits in performance, effectiveness, and productivity. The right hand side of the figure lists possible disadvantages of the individual incentive plans.

Potential Benefits	Possible Drawbacks
<ul style="list-style-type: none"> - Increased Productivity - Lower Production Costs - Less Direct Supervision - More Effective Use of Equipment - Entrepreneurial behavior Is Reinforced - Motivates Higher Performance - Variable Instead of Fixed - Individuals Better Understand How Their Performance Is Linked to Objectives - Distinguishes Between Performers - Focus on the Person, Not the Job 	<ul style="list-style-type: none"> - Lower Product Quality - Higher Implementation and Administrative Costs - Supervisory Suggestions May Be Seen as Distractions - May Increase the Risk of Accidents - May Not Account for Interrelated Behavior - Standards May Be Set Too High - There May Not Be Any Payment and Morale Will Suffer - Workers May Oppose Changes in Production Scheduling - Disparities in Pay May Cause Jealousy and Lower Morale - Potential for Rate Bias in Performance Evaluation

Figure 5. Individual Incentive Programs Pros and Cons (Peck, 1995)

If any organization is determined to be amenable to individual incentives, there are certain decisions to be made and steps to be taken. These decisions and steps include:

- Deciding which employees are to be included;
- Devising performance objectives to be achieved by participating employees;
- Devising criteria for assessing the achievement of the objectives;
- Deciding on the life of the plan;

- Deciding what training is needed for participants and administrators;
- Determining what changes, if any, need to be made in the existing pay system; and
- Evaluating and making any necessary changes to the administrative/reporting systems that will support the program.

2. Group Incentive Systems

Groups are defined as teams of individuals who work together to develop products or deliver services for which they are mutually accountable. In the individual incentive systems, employees are compensated based on their individual performance, whereas in the group incentive systems employees are evaluated based on how their teams perform. Group incentive systems are a means of rewarding performance in team settings. Performance measurements for groups include: historical output estimates, forward performance goals, or aggregated task standards. (Chingos, 1995)

There are various forms of group incentive systems currently being used in organizations. There is no template that can be placed in an organization to easily determine the most appropriate type of incentive system to implement. (Flynn, 1995)

There are many factors, such as strategy and culture, that are different in every organization. Ultimately, the group incentive systems fall into three categories: a proportion of the individual's base pay, other monetary rewards such as gain-sharing, and non-monetary rewards such as recognition and praise.

There are many factors an organization must consider before implementing any kind of group incentive system. For example, do the prerequisites exist for an effective

teaming environment that will create a strong foundation for implementing a group incentive system? Such prerequisites include, but are not limited to: interdependent jobs; accurate and objective measures of the team's performance; management support for teams, the organizational culture emphasizes cooperation among the team members at all levels; effective communication skills and flexible communication channels between managers and employees.

The move to group incentives affects employees in different ways. In a study conducted by Honeywell, Dickinson, and Poling (1997), both a group and individual incentive system were used in an experiment with 20 undergraduate psychology students. Those in the individual incentive condition earned more than those in the group condition. It was concluded that under a group incentive system, top performers decrease their performance when their earnings are reduced by poor performers. Poor performers continue to perform below average, because they can take advantage of the performance of other members.

In another study, conducted by Welbourne and Cable (1995), individuals stated that if companies stress the organizational role of the employee, then the employee would view their incentives as entitlements based upon that membership role. This situation will de-emphasize the "personal" role wherein the employee thinks only about himself and not about the organization as a whole; this helps the organization increase the employee's level of commitment.

Figure 6 summarizes advantages and disadvantages of the group incentive systems.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Motivates coordination of workforce • Encourages teamwork • Easier than individual systems in implementation • Less costly than individual systems • Increases cooperation between employees and management • Increases amount of communication within the organization • Increases flexibility between employees and management 	<ul style="list-style-type: none"> • Top performers may decrease their performance • Poor performers may perform below average • Large teams suffer from communication difficulties • It is too hard to build teams properly

Figure 6. Advantages and Disadvantages of Group Incentive Systems

3. Organizational Incentive Systems

An organizational incentive system is one in which the individual's incentive depends on the organization's overall performance. Organizational incentive systems are a category of group incentive systems. In general, organizational incentive systems are designed to encourage employees to either improve performance or contribute ideas on how to improve operations. The basic rationale behind these type of systems is that the level of productivity is a cumulative result of the entire workforce, (including support personnel such as the material handler and the janitor), and not just the production worker. (Welbourne and Cable, 1995)

Types of organizational incentive systems include Scanlon, Rucker, and gain sharing or profit sharing. (Ezzamel and Wilmot, 1998) All are similar in that they try to increase productivity by using different methods. Scanlon systems measure gains on sales dollars compared to labor costs. Rucker systems measure the value-added in manufacturing compared to labor cost. Gain sharing and profit sharing are team-based pay systems that provide an explicit link between business performance and team reward. (Patton and Daley, 1998)

The organizational incentive systems can be installed within a short period of time since they are simple and inexpensive to install and maintain. Therefore, these systems can have an immediate impact on performance. Another advantage of the organizational incentive systems is that all employees are directly or indirectly included. (Pelletier and Rahim, 1993)

The major disadvantage of the organizational incentive systems is that there may be low motivation at the individual level; an individual or group can find himself or herself performing very well but rewarded very little depending on how the rewards are calculated. (Pelletier and Rahim, 1993)

B. MONETARY INCENTIVES

A monetary incentive uses cash rewards to induce the desired behavior or results. The two main objectives of monetary incentives are: (1) improvement of the productivity, efficiency, and effectiveness of the organization, and (2) enhancement of employee job satisfaction. From a motivational standpoint, there are two kinds of compensation within monetary incentives: fixed pay and variable pay.

Fixed pay gets its name because it seldom changes more than once a year, and typically those increases are relatively small. Almost all government employees are paid with fixed pay. Its effect on job performance is somewhere between marginal and nonexistent. According to (Gellerman, 1992), "hardly anyone pumps extra time, effort, or imagination into his work just to get the same check every payday."

Variable pay is paid out in varying amounts, and can be quite substantial relative to fixed pay. Variable pay is defined as compensation other than base wage or salary that is awarded on the basis of a specific standard of performance. (Gellerman, 1992)

Variable pay does not encompass cost of living increases, fails to recognize changes in the purchasing power of money to any reasonable extent, and has little or no motivating power of its own. The 10 major forms of variable pay presently used are (Peck and Parkinson):

- *Current Profit Sharing*: Uniform payment to all or most employees based on an organizational profitability formula.
- *Gain-sharing*: Plans designed to measure the productivity of a group, unit, or organization, and to share the value of productivity gains uniformly with all participants.
- *Individual Incentive*: Payment based on a standard of individual performance.
- *Instant Incentive*: Special payment to an individual for a noteworthy achievement.
- *Merit Bonus*: Payment based on individual performance appraisal given in lieu of, or in addition to, a merit increase and never added to base salary.
- *Organization-wide Incentive*: Variable payment based on a measure of organizational performance.
- *Pay-For-Knowledge*: Pay increase based on the number of skills or jobs mastered.
- *Restricted Stock/Stock Option*: Grants to non-executives of stock subject to restrictions or options to purchase stocks.
- *Small Group Incentive*: Uniform award to all members of a group, based on their achievement of predetermined objective.
- *Two-Tier Pay*: New hires (second tier) in a particular occupation are paid on a lower scale than previous hires.

Monetary incentives are becoming "rights" rather than rewards. The increasing demand for material rewards is rapidly destroying their usefulness as incentives and managerial tools. (Nelson, 1995) Monetary incentives have in some cases been found to have a demotivating effect. Monetary incentives can reduce teamwork as employees concentrate primarily on individual cash gains. Some organizations pointed out a negative boomerang effect, while others reported ongoing problems with timely response and noted disagreements on determining dollar amounts.

While there are ways to motivate employees using money, much of the money spent on motivation is wasted, because there is little knowledge about what money *can* and *cannot* do. There is a limit on how much people are willing to give up just to make more money—particularly if the extra money is a relatively small amount. To motivate people with money, you may have to offer them a lot of money. However, many times a company must spend a great deal of money in exchange for a small increase in effort—a rather uneconomical proposition for the "motivator."

The employees earn their living by selling their time and effort, but not all of their time and effort is for sale. Most individuals want to reserve some of their time and energy for their own endeavors. If a company wants to buy additional time and effort from its employees, it comes down to a question of price. The time and effort not already sold will cost more than the time and effort they have sold. The employees might be willing to sacrifice their extra time and effort just for enough money. So if you use nothing but money to buy employees' unsold time, the arrangement will quickly become so expensive that no company could afford to keep up with the rising cost of this type of system. (Gellerman, 1992)

C. NON-MONETARY INCENTIVES

A reward is not just about money— a reward can also include non-monetary returns that promote motivation. Non-monetary incentives are personal and flexible, and thus can be more widely used. They can have greater impact in motivating more people and in helping to reinforce organizational structure. With relatively little effort and expense, management can obtain the benefits of non-monetary incentives that help employees increase their performance and productivity.

The current value of non-monetary rewards as employee motivators is increasing for two reasons. First, traditional rewards are becoming less and less effective in motivating today's employees to achieve high performance. Second, non-monetary rewards are effective and highly desired by today's employees. (Nelson, 1996)

The most effective motivators for employees are often such intangibles as being appreciated for the work they have done, being kept informed about things that affect them, and having a sympathetic manager who takes time to listen to them. (Nelson, 1996) None of these intangibles are very costly.

Studies conducted in the incentive area have shown that one can obtain a greater increase in productivity through the use of non-monetary incentives. In a study of manufacturing team motivators, more than half of the manufacturers say incentive systems work best when they include non-monetary incentives such as recognition programs, training and development, and changes to work content. (McKenzie and Lee, 1998) Many other studies have shown that employees find the most meaningful incentives to be things that are free, such as a personal thank-you from one's manager for doing a good job.

Although non-monetary incentives are given little or no attention in management literature and practice, they are very effective. In a recent survey of American workers, 63% of the respondents ranked "a pat on the back," as a meaningful incentive.

(Mischnick, 1998) In another recent study of 65 potential incentives, four out of the top five incentives that employees ranked as the most successful motivators were (a) initiated by their managers, (b) based upon performance, and (c) required little or no money, (e.g., letters of congratulations to the employees, personal notes for good performance, recognition, and morale-building meetings). (Nelson, 1996)

Employee recognition is a very effective and feasible way in which a non-monetary incentive can be implemented, especially within government organizations. (Nelson, 1996) Some of the most effective forms of recognition cost nothing at all. A sincere word of thanks from the right person at the right time can mean more to an employee than a raise, a monetary award or a whole wall of certificates or plaques. Part of the power of such incentives comes from the knowledge that someone took the time to notice the achievement, seek out the employee responsible, and personally deliver praise in a timely manner. (Nelson, 1996)

Peters, T. and Waterman, R. (1982) report the wealth of non-monetary incentives used by the companies which they studied:

At Foxboro, a technical advance was desperately needed for survival in the company's early days. Late one evening, a scientist rushed into the president's office with a working prototype. Dumbfounded at a elegance of the solution and bemused about how to reward it, the president bent forward in his chair, rummaged through most of the drawers in his desk, found something, leaned over the desk to the scientist, and said, "Here!" In his hand was a banana, the only reward he could immediately put his hands on. From that point on, the small "gold banana" pin has been the largest accolade for scientific achievement at Foxboro.

Non-monetary incentives are most effective when a few simple guidelines are followed. Non-monetary incentives need to:

- ***Clearly reward the specific, desired behavior.*** The incentive needs to be given in response to the desired behavior.
- ***Immediate.*** Non-monetary incentives need to be given as soon as possible after the desired behavior occurs.
- ***Delivered personally.*** Part of the power of non-monetary incentives from the way they are personally delivered.
- ***Valued by the individual.*** A final guideline for making non-monetary incentives effective is to be sure they are valued and meaningful to the individuals who receive them.

D. CHARACTERISTICS OF AN EFFECTIVE INCENTIVE SYSTEM

No perfect incentive system exists, not within any organization or within any economy. However, there is likely an appropriate combination of incentive systems for both private and public organizations.

A true incentive system implies potentially unlimited rewards for success and a genuine penalty for failure. An incentive system should also extend the time horizon for decision-making, and encourage good performers to stay and poor ones to leave.

As mentioned above, there is no guarantee that every incentive system will be successful. However, understanding and applying the following key points can enhance the probability of building an effective incentive system. (Hornestay, 1996)

- Incentive systems *focus on the desired behaviors* and provide the performer with a direct connection between action and the result.
- Incentive systems should be *meaningful*. The value of the reward is worth the effort to both performer and organization.
- The incentives should be provided as *timely* as necessary to reinforce the desired behaviors that achieve desired results.
- The incentives should be provided *contingent* on taking an action or achieving a result.
- The system should be *simple* to understand. If the system needs to be complex, the organization should provide ongoing training for its employees.
- Incentive systems should be *built upon past programs*. A company should build upon and learn from the previous incentive program to launch a successful follow-up program.
- The *managers need to be highly motivated to maintain the incentive system* being used within their organizations.
- Incentive systems need to *have a positive impact on behavior*.
- Incentive systems need to *focus efforts on serving the customer*.
- Incentive systems need to *enhance collaboration* within the workplace.
- In situations where unions are representing employees, they should be *included in the process* of implementing incentive systems to guarantee coordination.
- Incentive systems should be *continuously maintained*.

IV. DIFFICULTIES IN IMPLEMENTING INCENTIVE SYSTEMS AND A PROPOSED INCENTIVE SYSTEM

A. INTRODUCTION

Chapter III reviewed incentives and incentive systems currently used in both private and public sectors. This chapter examines the applicability of these systems to the Turkish Naval Shipyards under the existing constraints. This chapter also proposes a viable incentive system for the shipyards.

B. APPLICABILITY OF THE INCENTIVE SYSTEMS

The private sector uses the incentive systems reviewed in the previous chapter to increase profit by increasing productivity. Any organization wishing to reduce labor cost, cycle time, waste and inefficiency, and increase quality and performance is looking to improve productivity. Any organization may benefit if it can properly implement an incentive system. Although the Turkish Naval Shipyards are not intended to generate a profit, they are supposed to maximize efficiency in using tax money or minimize cost by increasing their productivity.

Since the shipyards are government owned facilities, it is not as simple as it is for the private sector to implement an incentive system. Therefore, the implementation of an incentive system is likely to face a number of barriers that may complicate or prevent attempts to install an incentive system. Nevertheless, implementing a feasible incentive system under the existing constraints may be a strong support mechanism for the shipyards to increase employee productivity and maximize efficiency in using tax money.

1. Culture

Culture includes traditions, values, attitudes, shared memories, and just about any common characteristic that unites a group. We have to take into account the conditions under which incentive systems are made available to members. Since culture is the most important factor that influences the most effective types of incentives, we cannot ignore cultural factors while choosing a feasible incentive system for the Turkish Naval Shipyards.

The work environment of the shipyard personnel, both managers and civilian workers, has remained constant and relatively unchanged since its inception. Almost everybody looks forward to ending the workday as soon as possible after finishing his daily schedule. Therefore, the personnel do not want changes that affect their daily lives in the shipyard.

There is a traditional management and work system in place at the shipyard. Of course, technological changes take place within the shipyards. The personnel can easily adapt to these changes with the help of additional training and education. These changes only affect the way of completing the tasks themselves-- they do not affect the behaviors, attitudes, or the relationships of the employees. On the contrary, a new incentive system would mean changes at every level of shipyard. A new incentive system would be a big change, because the current compensation system has only superficial incentives: The employees know how the current system works and believe that the existence of an incentive system does not make any difference in their routine work life because of its weak implementation. Yet, the implementation of an alternative incentive system would

be totally different from the current one. The work environment, all routine processes, relationships, managers, employees, and customers (ship personnel) would be affected.

Before implementing a new incentive system, one must convince people of the importance, benefits, and feasibility of the system. To get satisfactory results from the system, each individual should understand the rationale for the proposed change. Thus, within the existing environment, it may take a long time to change existing attitudes and behaviors.

In the shipyards, most of the labor is performed at lower levels. The officers who are responsible for supervising the workers at these levels do not have flexibility in managing their employees or the power to make changes or strategic decisions. The management believes that officers hold exclusive responsibility for completing every job in the shipyard. Typically, given the potential consequences of deviating from one's assigned mission, these officers are not willing to take risks-- they merely struggle to ensure that all tasks are completed without considering critical factors such as worker productivity, quality, and time. The civilian workers do not take responsibility even for their own jobs, because they are aware that their managers will be blamed if something goes wrong.

The implementation of an incentive system requires managers at all levels to evaluate the productivity and performance of the employees. Within the naval shipyard context, the managers are not interested in productivity and performance of their employees. They have only enough power and time to make sure that the jobs are done under that much responsibility with little empowerment

Some of the managers and senior civilian workers have the propensity to "own" any job well done by the workers under their supervision. These people are always jealous of the other workers who report to them. They do not allow the high-achieving performers to show their successes to the management. Therefore, to some extent, workers under these kinds of managers cannot find any reason to perform well. Then, good performers become bad performers, and bad performers continue to perform badly. It is virtually impossible to reward the outstanding workers properly because of their managers' reluctance to share in the formal recognition of such individuals.

The compensation systems of the officers and the civilian workers are different, and there is a dilemma about the amount of these two payments. Even though the officers are managers to whom the civilian workers report, they make less money than the civilian workers. Most of the officers think that the civilian workers are already adequately rewarded. These officers may believe that a new incentive system should be implemented just for the officers, or ask for some extra monetary incentives that can make their salaries at least equal to the workers' salaries. There is a common idea among the officers that it would not be fair to reward their employees, particularly since the officers are making less money than these employees.

Relationships between managers and the employees are not always as professional as they should be. There may be some managers who give their employees preferential treatment because of their mutual interests. Nobody can say that these kinds of managers evaluate their employees' productivity and performance objectively. Under such a condition, some employees may be rewarded even though they do not deserve

such recognition, or some of them may be ignored despite their superior performance. These effects are likely to cause conflicts among the employees.

The personnel's emphasis on the value of time is very weak-- the concept of "time is money" does not apply in the shipyards. Generally, personnel ignore the price of poor time management. There are few people who use their time effectively. Working always behind schedule has become the social norm within the shipyards. This is one of the most critical cultural barriers that one may encounter in implementing an incentive system. Therefore, the feasible incentive system should be powerful enough to successfully address the current "laid back" philosophy so that workers can begin to reach the desired productivity levels.

2. Performance Measurement

Kerr (1975) emphasizes the need to reward performance based on objective criteria that reflect the mission of the organization. He also indicates that a misdirected incentive system cannot improve performance in desired areas. Additionally, performance in public agencies can be more difficult to measure than in some private sector organizations. (Milakovich, 1995) The performance measurement in the private sector is often related to profits or financial ratios. Since the Turkish Naval Shipyards do not operate on a profit basis, it is difficult to clearly define desirable performance.

In order to fairly evaluate the performance of individuals and groups, the shipyards' mission has to be made crystal clear to every individual. Every employee must understand the mission and objectives of the shipyard, the employee's own mission, and the manager's vision of the desired performance. Once these prerequisites have been

established, the managers can evaluate their employees' performance. The shipyard management's policy about establishing and clarifying missions, objectives, and desired performance is somewhat weak, because the management does not consider these issues as important as they should be.

The level of customer satisfaction is a good indication of performance. Customers, in this case the ship personnel, play an important role in recognizing employee performance. They are the ones who will use all ship systems on which the shipyard personnel work. Customers are in the best position to say which employees are good performers, and which employees are not. The ship personnel know who is responsible for what repair work during the overhaul process. Currently, the role and participation of ship personnel is almost non-existent during the overhaul maintenance period. An effective incentive system would require the ship personnel to be involved to the greatest extent possible.

Feedback is a critical element in implementing an incentive system. Without feedback, it is impossible for an individual to calibrate his or her performance. Feedback has also been judged as essential for learning, directing actions, growth, shaping attitudes, and motivating employees. (Glinow and Sethia, 1983) The extent to which an organization can increase the usability of employee feedback is contingent upon giving the evaluators appropriate information about the employees' expected and actual performance.

In the shipyards, the immediate senior officers and the managers should be responsible for the performance evaluation. The hierarchical superior may lack the competence, time, or ability to observe performance. When that happens, the hierarchical

superior may not have a valid, credible, or trustworthy basis for evaluation. (Glinow, 1988)

3. Budget

Where incentive systems are contingent upon appropriating funds, potential barriers will include additional factors affecting the implementation of the incentive program. Unlike other types of incentives, monetary incentives by nature require that special funds be made available for rewarding employees. (Greiner, 1978)

Military budgets do not change within the fiscal year after receiving formal approval. There may be two kinds of change in the next year's budget. First, the government can increase next year's budget according to the inflation rate. Second, if any military organization is successful in improving productivity and saving money, the savings may *not* be recycled back into that specific organization's budget. Saving this year could lead to future budget cuts for those organizations. This "punishment" may discourage shipyard management from implementing an incentive system.

Like the other military organizations, the shipyards do not have any funds within their budgets, to finance an incentive system. Since the government (not the shipyards), pays the salaries of both officers and civilian employees, there is not any appropriated money, to pay the employees as an incentive.

4. Laws and Regulations

When incentives require special appropriations, legal constraints built into the appropriation laws must be considered. The Turkish Government has laws, not only for the military but for all government organizations, which prohibit military organizations from giving employees any cash rewards except for regular wages and salaries.

There is a law that regulates salary increases for military personnel. There are two increases in salaries within a year, depending on the inflation rate. This law does not allow the government to give military personnel any incentive payment other than their original salaries.

The shipyard civilian employees have their own unions, and there are also laws that regulate their salaries. Civilian employees' salary increases are determined through negotiations that are held once a year between the government and the unions. These increases are always higher than the increases in the military personnel's salaries. As mentioned earlier, the difference between these two salaries may create a conflict between military and civilian personnel within the shipyards while implementing an incentive system.

C. ORGANIZATIONAL AND INDIVIDUAL GOALS

The organizational goal of the Turkish Naval Shipyards in implementing an alternative incentive program is to increase quality and productivity. A secondary goal is to successfully integrate the program under the existing constraints explained above and to identify necessary modifications to the policies and practices within the shipyards.

With these organizational goals in mind, the foundation for an alternative incentive system can be developed.

The incentive system must be framed around a set of core assumptions that emphasize the linkage between people and organizations. (Simons, 1995) People are an organization's most important resource. The performance of an organization depends on how it recruits, hires, trains, and retains people and promotes effective performance of its people. (Simons, 1995)

The process for selecting an alternative incentive system must be based on the desired outcomes of the incentive system and alignment of individuals with the Turkish Naval Shipyards' organizational goals. The task of aligning performance measurement criteria with reward criteria is a challenging one that requires focus and continual measurement. (Stone and Gerard, 1997)

First of all, we must determine and prioritize individual goals to align individual and organizational goals. Jurkiewicz, Massey and Brown (1998) identified the following 15 "wants" for both public and private sector employees.

1. A stable and secure future
2. A chance to learn new things
3. A chance to use one's special abilities
4. High salary
5. Opportunity for advancement
6. Variety in work assignments
7. Working as part of a team
8. Chances to make a contribution to important decisions
9. Friendly and congenial associates
10. A chance to benefit society
11. Chance to exercise leadership
12. Freedom from supervision
13. Freedom from pressures to conform both on and off the job
14. Chance to engage in satisfying leisure activities
15. High prestige and social status

A list containing the above "wants" was given to 296 public employees in a variety of fields, and they listed the items in order of priority. Private sector employees ranked the same wants in a different order. For example, the top three private sector employee "wants" in order were: a high salary, a chance to exercise leadership, and opportunity for advancement. There are no matches among the top three wants in the public and private sectors. This fact indicates that public sector employees may be motivated differently than private sector employees; it also implies that using non-monetary incentives can be well suited for public sector employees.

The 15 items listed above provide a prioritized lists of objectives for an ideal incentive system. All of these objectives are not valid, especially because of cultural factors existing within the shipyards. Within the existing work environment and shipyard cultural factors, some of these objectives can be met immediately using an incentive system. They are listed below in Figure 7. Collectively, achieving these objectives can be viewed as a goal for the shipyards. These goals are listed according to their priorities.

1. A stable and secure future
2. Freedom from supervision
3. Chance to use my special abilities
4. Chance to learn new things
5. High salary
6. Working as part of a team
7. Chance to make a contribution to important decisions

Figure 7. Incentive System Direct Goals

The criteria listed above can be used to compare and contrast alternative incentive systems, and thus evaluate the system's potential effectiveness. The most viable incentive system may be the one that best meets the shipyards' organizational goals, as well as the employees' goals.

D. A PROPOSED INCENTIVE SYSTEM

To identify a viable incentive system for the Turkish Naval Shipyards, the existing constraints must be considered, and the incentive system most likely to meet organizational and employee goals must be identified.

Monetary incentives are least likely to be used in the shipyards under the current statutory limitations. Monetary incentives may only meet the criteria of a high salary.

Moreover, monetary incentives are limited due to the laws and regulations that limit the government to (i) paying salaries to public sector employees, and (ii) increasing their salaries once or twice a year. However, the increases in salaries for both military and civilian personnel may surpass the inflation rate to help the employees afford the cost of living. We may use these increases as monetary motivators within the incentive system to increase productivity.

Accordingly, we have to emphasize non-monetary incentives, since most of the constraints explained before are directly linked to the monetary incentives. Non-monetary incentives can meet all of the direct goals except high salaries for shipyard employees. Within the context of the Naval Shipyards, non-monetary incentives are the most feasible incentives. There is no law or regulation that prohibits the shipyards from rewarding employee performance with non-monetary incentives. An additional plus is that non-monetary incentives do not further increase the existing economic gap between the military and civilian personnel.

Taking the cultural and financial issues into consideration, the positive effects of an incentive program can be best achieved through non-monetary incentives. Non-monetary incentives can be motivating rewards and require little or no money. Current surveys and studies indicate that employees prefer rewards, recognition, and praise to money. (Nelson, 1996) The specific types of non-monetary incentives that can be used in the shipyards will be listed in Chapter VI.

An organizational incentive system may require the least amount of effort and time to implement, and can meet the shipyards' organizational goals. Organizational plans recognize that the organization's success results from the effort of everyone

involved, not just an individual or a group. However, organizational incentive systems fail to address outstanding performance at the individual and group level. Within this system, there are no opportunities to identify strong or weak performers. In the shipyards, it is very difficult to develop a single organizational incentive system that affects all employees equally.

Group incentive systems encourage employees to work as a team and provide opportunities for individuals to exercise leadership. Working as a group may reduce the need for direct supervision. In shipyards, almost all of the tasks require collaborative efforts due to the nature of the jobs. Each facility within the shipyards carries out a specific job for the ships. The workers in each facility complete repair works in groups. For example, the gun facility has five groups: removal, repair, calibration, paint, and installation. The groups already exist within the facilities at the shipyards. It is much easier and cheaper to implement a group incentive system within the current work structure. Therefore, a group incentive system may be the most feasible for the shipyards. A group incentive system would most likely have positive impacts on productivity and quality of the shipyards.

An individual incentive system has the capacity to affect the following individual goals: stable and secure future, the chance to learn new things, the chance to use special abilities, variety in work assignments, the chance to make a contribution to important decisions, and opportunity for advancement. Higher implementation costs, lower quality of work, and the potential for an increased accident rate may be some drawbacks of an individual incentive system. Because of the culture of shipyards and the difficulty of standardizing performance measurement, an individual incentive system may not be the

best fit for the shipyards; however, it is more feasible than an organizational incentive system.

The most viable incentive system for the Turkish Naval Shipyards would be a group incentive system using mostly non-monetary incentives. Under this system, individuals can be rewarded in addition to their group awards when they make outstanding contributions that significantly increase group performance.

Currently, both private and public organizations have implemented group incentive systems using non-monetary incentives within the United States. The following paragraphs provide some of the research results, survey results and statistics about organizations implementing incentive systems similar to the one proposed here.

There are examples of private organizations getting benefit from using non-monetary incentives. The impact that some companies have observed using non-monetary incentives to drive desired performance objectives, include (Nelson, 1996):

- An Amoco plant saved \$18.8 million in two years using of recognition gift programs.
- The Travel Related Services division of American Express attributed a 500 percent increase in net income over 11 years to recognition programs.
- American Airlines, using a points-for merchandise recognition program, was able to purchase a new airplane with \$50 million in savings from increases in employee performance.

According to Nelson (1996), Robert Half International, the nation-wide staffing firm, conducted a survey of why people leave their jobs and found the primary reason to be a lack of praise and recognition.

Nelson (1996) describes other examples of non-monetary incentives within different organizations, including:

- *At the Honeywell Technology Center of Honeywell Inc., management implemented a team based recognition program called "The Winning Edge" for superior team performance. The program was a success in getting employees to pay extra attention in helping others with their needs, increasing the general morale and excitement of the work environment, and increasing productivity of the company.*
- *At AT&T Universal Card Services in Jacksonville, FL, they use the Word of Thanks award as one of more than 40 recognition and reward programs. It is a pad of colored paper shaped like a globe with "Thank You" written all over it in different languages. Anyone in the company can write a message of thanks to someone else and send it to that person. The program is extremely popular—in four years they have used over 130,000 such notes.*
- *ARA services headquartered in Philadelphia, PA, organizes a day of appreciation for worthy employees. They send out a proclamation announcing Bob Jones Day, for example, with the reason for the honor. The honoree enjoys all sorts of frills, such as computer banners and a free lunch.*
- *The Office of Personnel Management in Washington, DC, uses a "pass around" award that was first given to the division's "special performer." Later that person passed the award to another who, he believed, truly deserved it. The award came to take on great value and prestige because it came from one's peer. When the award is to be passed on, a ceremony and a lunch are planned.*

Some public organizations also benefit from using non-monetary incentives to improve productivity of organizations. United States Office of Personnel Management Department (Federal Government's Human Resources Agency) researched about the results of incentive systems being implemented within public organizations. Some of the research results are:

- In 1995, the General Service Administration's (GSA) Realty Services Division established a group incentive program that balanced individual and

team recognition. Currently, productivity has been high and teams are providing assistance to one another in meeting the organizational goals.

- The Rock Island Arsenal, the largest government-owned weapons manufacturing arsenal in the western world, has designed a group incentive program that effectively balances team and individual recognition, and takes advantage of non-monetary incentives. The arsenal improved its productivity by 17 percent after implementing this incentive program.
- The Veterans Affairs Health Care Network in Upstate New York established a recognition program that rewards individual and group behavior. This program helped the Network achieve the following results: (1) the *Network* exceeded its goal for reducing costs by 9.5 percent; (2) the *Network* increased the number of veteran patients by 16 percent; (3) the *Network* generated \$107,650 in savings; (4) the *Network* improved its productivity by 20 percent.

The previous paragraphs provided examples of group incentive systems successfully implemented within the United States using non-monetary incentives. At the Turkish Naval Shipyards, the work environment and culture are not the same as these organizations. Therefore, these examples may not necessarily prove that such an incentive system will work at the Turkish Naval Shipyards. However, these successful examples at least show that such an incentive system may work. We can suggest that a group incentive system with non-monetary incentives, which works at some American public and private organizations, might also work at the Turkish Naval Shipyards.

V. SIMULATION MODEL

B. INTRODUCTION

In this chapter, a simulation model of the overhaul maintenance process is built using Arena simulation software. This chapter also analyzes the results of the tests performed using the simulation model to review potential impacts of an incentive system within the Turkish Naval Shipyards.

C. SIMULATION MODEL

1. Problem Statement

As stated in Chapter 1, there are three types of ships that receive overhaul maintenance. When the ships arrive at the shipyard, the engines, guns, and anchors are removed from the ships. Large ships have six engines, six guns, and two anchors. Medium ships have four engines, four guns, and two anchors. Small ships have two engines, three guns, and one anchor. After removal, engines, guns, and anchors are sent to the engine, gun, and anchor facilities, respectively, for repair. Then, other facilities (i.e., dry dock, wood work, electric, electronic, navigation, and paint) begin repairing the ship. All facilities serve each type of ship simultaneously. When all repairs are complete, the parts removed from the ships are re-installed, and finally the ships leave the shipyard.

Assumptions: The time between overhaul maintenance for each type of ship is: 48 months for large ships, 40 months for medium ships, and 36 months for small ships. The removal and installation and drydock facility process times are assumed to follow

triangular distributions. The facility process times are assumed to follow uniform distributions, and are provided for each type of ship in Figure 8 below.

Process times (months)	Large Ships	Medium Ships	Small Ships
Removal	TRIA (.5,1,1.2)	TRIA (.3,.5,.8)	TRIA (.25,.5,.75)
Installation	TRIA (1,1.25,1.5)	TRIA (.75,1,1.25)	TRIA (.5,.8,1)
Engine Facility	UNIF (3,5)	UNIF (2,4)	UNIF (1.5,3)
Gun Facility	UNIF (2,3)	UNIF (1.5,2)	UNIF (.8,1.25)
Anchor Facility	UNIF (1,1.5)	UNIF (.75,1.25)	UNIF (.5,1)
Drydock Facility	TRIA (1.25,1.5,2)	TRIA (.75,1,1.25)	TRIA (.5,.75,1)
Woodenwork Facility	UNIF (1,2)	UNIF (.5,1.5)	UNIF (.5,1)
Electric Facility	UNIF (1.5,2.5)	UNIF (1,1.5)	UNIF (.75,1.25)
Electronic Facility	UNIF (1.75,2)	UNIF (1.25,1.75)	UNIF (1,1.25)
Navigation Facility	UNIF (1,1.5)	UNIF (.75,1.25)	UNIF (.75,1)
Paint Facility	UNIF (.5,1)	UNIF (.25,.75)	UNIF (.25,.5)

Figure 8. Process Times

2. Model

The simulation model for the overhaul maintenance process is built using the data given above. In this model, we used 14 different modules: Create, Delay, Assign, Duplicate, Server, Batch, Store, Unstore, Match, Tally, Dispose, Variable, Expression, and Simulate. A picture of the model is shown in Figure 9.

Phase 1:

At the beginning of the simulation model, three types of ships arrive at the shipyard with different arrival rates. The ships are created using the *Create* module, and the time between overhaul is defined in the *Delay* module. Then, the time of entrance to the shipyard is recorded and operational availability for each type is calculated in the *Assign* module.

Phase 2:

The removal time of the engines, guns, and anchors is defined within the *Delay* module. When the engines, guns, and anchors are removed from the ships, these parts are sent to the engine, gun, and anchor facilities by the *Duplicate* module. To be able to identify which parts belong to which type of ships, these parts are batched based on their ship types using the *Batch* module.

Phase 3:

After completing these steps, other facilities (Drydock, Woodenwork, Electric, Electronic, Navigation, and Paint) begin making repairs on the ships. All these facilities are simulated with the *Server* module. The process times of the facilities for each type are also defined in the server modules.

Phase 4:

After all facilities finish their designated tasks, the re-installation of the parts removed from the ships is simulated using the *Match* module. This module matches the ship with its respective parts. Again, the installation time is defined within the *Delay* module.

Phase 5:

Finally, the *Tally* module collects statistics about the simulation. Since ships receive overhaul maintenance periodically, the repaired ships are sent to the beginning of the simulation to make a closed loop at the end of the model. The same processes mentioned above are repeated over and over in the simulation model.

3. Analysis

When we run the simulation model, we get statistical results. These results are average cycle times and operational availabilities for each type of ship, and average queue times and utilization factors for each facility. Figure 10 shows these statistical results.

ARENA Simulation Results
Replication ended at time : 600.0
TALLY VARIABLES

Identifier	Average	Half Width	Minimum	Maximum	Observations
largeships cycletime	15.821	(Insuf)	8.8674	45.300	45
smallships cycletime	11.602	(Insuf)	3.4779	20.878	37
Drydock_R_Q Queue Time	.23010	(Insuf)	.00000	4.8016	127
Gun_R_Q Queue Time	4.5724	(Corr)	.00000	33.383	559
Paint_R_Q Queue Time	.02595	(Insuf)	.00000	.53523	126
Navigation_R_Q Queue T	.05783	(Insuf)	.00000	.83195	126
Electric_R_Q Queue Tim	.03367	(Insuf)	.00000	.73779	126
mediumships cycletime	13.266	(Insuf)	6.0354	19.683	43
Anchor_R_Q Queue Time	.46009	(Insuf)	.00000	6.3145	217
Woodenwork_R_Q Queue T	.00613	(Insuf)	.00000	.28098	127
Electronic_R_Q Queue T	.03460	(Insuf)	.00000	.67234	126
Engine_R_Q Queue Time	9.5884	(Corr)	.00000	42.087	518

DISCRETE-CHANGE VARIABLES

Identifier	Average	Half Width	Minimum	Maximum	Final Value
OPAVMEDIUM	.69298	(Insuf)	.00000	1.0000	.75000
Engine_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Anchor_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Electric_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Navigation_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Woodenwork_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
# in Navigation_R_Q	.01214	(Insuf)	.00000	2.0000	.00000
Drydock_R Busy	.21071	(Insuf)	.00000	1.0000	.00000
# in Anchor_R_Q	.16640	(Insuf)	.00000	9.0000	.00000
# in Engine_R_Q	8.3110	1.6453	.00000	37.000	8.0000
Electric_R Busy	.16856	(Insuf)	.00000	1.0000	.00000
OPAVSMALL	.70150	(Insuf)	.00000	1.0000	1.0000
Electronic_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Paint_R Busy	.11621	(Insuf)	.00000	1.0000	.00000
Engine_R Busy	.93897	(Corr)	.00000	1.0000	1.0000
Anchor_R Busy	.18967	.03295	.00000	1.0000	1.0000
Navigation_R Busy	.15135	(Insuf)	.00000	1.0000	.00000
Woodenwork_R Busy	.14731	(Insuf)	.00000	1.0000	1.0000
OPAVLARGE	.68203	(Insuf)	.00000	1.0000	.80000
Gun_R Busy	.76144	.08846	.00000	1.0000	1.0000
Electronic_R Busy	.14399	(Insuf)	.00000	1.0000	.00000
# in Gun_R_Q	4.2687	1.3497	.00000	31.000	4.0000
# in Paint_R_Q	.00545	(Insuf)	.00000	1.0000	.00000
Paint_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
Gun_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
# in Woodenwork_R_Q	.00130	(Insuf)	.00000	1.0000	.00000
Drydock_R Available	1.0000	(Insuf)	1.0000	1.0000	1.0000
# in Electric_R_Q	.00707	(Insuf)	.00000	1.0000	.00000
# in Drydock_R_Q	.04870	(Insuf)	.00000	4.0000	.00000
# in Electronic_R_Q	.00727	(Insuf)	.00000	2.0000	.00000

Figure 10. Simulation Summary Report

At the beginning of the simulation, five large ships, four medium ships, and three small ships are created. We run the simulation model once for 600 months and the results show that 45 large ships, 43 medium ships, and 37 small ships enter the maintenance process during the simulation period.

We run the simulation model 20 times to get valid statistics for the ships. The average cycle time and operational availability for each type of ship are shown in Figure 11.

Replication	Average Cycle Time			Operational Availability		
	Large	Medium	Small	Large	Medium	Small
1	15.821	13.266	11.602	0.682	0.693	0.702
2	16.299	12.402	11.893	0.678	0.705	0.702
3	15.796	13.625	13.124	0.682	0.689	0.678
4	16.721	12.772	12.182	0.672	0.699	0.696
5	15.598	13.338	12.821	0.685	0.692	0.684
6	16.650	13.282	13.005	0.674	0.691	0.680
7	16.390	13.733	12.683	0.676	0.687	0.686
8	15.834	12.114	11.949	0.682	0.709	0.701
9	16.822	12.860	12.085	0.671	0.698	0.697
10	16.459	12.747	12.188	0.676	0.699	0.696
11	16.756	12.805	12.677	0.672	0.700	0.686
12	16.383	12.145	12.501	0.677	0.710	0.690
13	16.468	12.876	12.247	0.675	0.697	0.695
14	16.382	12.831	12.095	0.676	0.698	0.698
15	16.209	12.962	12.361	0.678	0.696	0.693
16	16.270	12.663	12.671	0.678	0.701	0.687
17	16.324	11.809	12.471	0.677	0.715	0.691
18	16.012	12.760	12.247	0.680	0.699	0.695
19	16.297	13.032	12.064	0.677	0.698	0.699
20	16.631	12.713	12.145	0.673	0.700	0.693
AVG	16.306	12.837	12.351	0.677	0.699	0.692
Std.Errors	0.0750	0.1051	0.0847	0.0008	0.0015	0.0015

Figure 11. Statistics for Ships

According to naval maintenance documents, the scheduled overhaul cycle time for the large ships is approximately 10 months. In the simulation, the average overhaul

cycle time for large ships was 16 months within current productivity. The average operational availability for large ships is sixty seven percent.

The scheduled cycle time for medium ships is eight months. The average simulated overhaul cycle time for medium ships is 13 months, and the average operational availability of medium ships is sixty nine percent.

The scheduled overhaul time for the small ships is six months. The simulated overhaul cycle and operational availability for small ships are 12 months and sixty nine percent, respectively.

The results of the simulation show that the actual overhaul maintenance process for each type of ship takes almost five more months longer than scheduled process. The simulated overhaul cycle times for each ship type are very close to actual cycle times within current productivity at the shipyards. Practically, the overhaul process takes three or four months longer than scheduled process for almost half of the ships within the entire navy. Because of the long overhaul maintenance cycle times, the operational availability of the ships would be low. The average operational availability of all ships is shown in Figure 12.

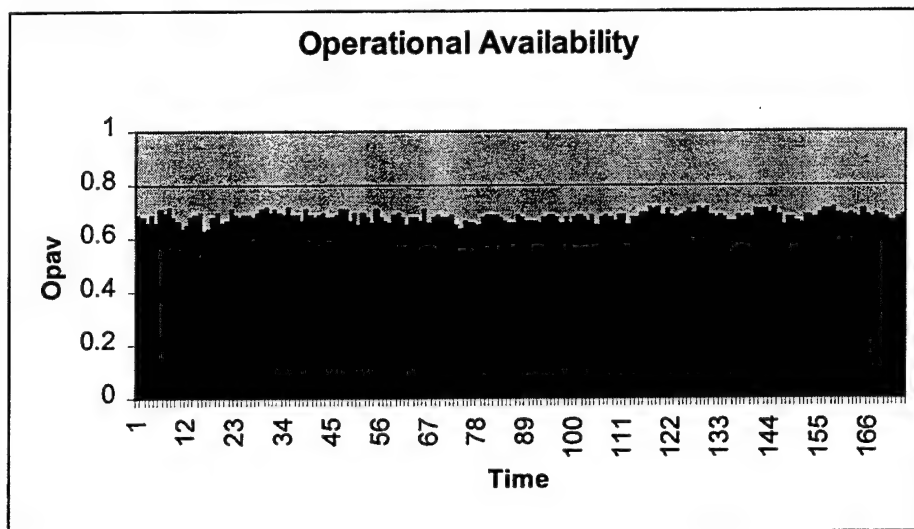


Figure 12. Operational Availability

As shown in the graph above, the average operational availability of the ships is approximately sixty nine percent, implying that thirty percent of the ships are not operational at any time. Low operational availability causes low readiness. Therefore, with the current productivity level, overall Navy readiness would also be low.

When a ship or any part of a ship arrives at any facility, it waits in the queue for service. This queue waiting time makes the overhaul cycle time longer than standard cycle time. The simulation model also calculates queue times of each facility based on process times. These queue times are taken from the summary report and shown in Figure 13.

	Average Queue Times								
Replication	Drydock	Gun	Electric	Navigation	Paint	Electronic	Wooden	Anchor	Engine
1	0.230	4.572	0.034	0.006	0.026	0.035	0.006	0.460	9.588
2	0.201	3.957	0.030	0.029	0.024	0.026	0.004	0.439	9.568
3	0.247	4.517	0.048	0.072	0.034	0.040	0.016	0.503	9.890
4	0.218	4.051	0.065	0.071	0.031	0.040	0.015	0.046	9.959
5	0.252	4.706	0.061	0.081	0.038	0.045	0.007	0.497	9.685
6	0.194	4.724	0.017	0.022	0.020	0.012	0.005	0.455	10.155
7	0.234	4.841	0.037	0.035	0.026	0.026	0.007	0.468	10.180
8	0.205	4.163	0.033	0.028	0.015	0.025	0.009	0.436	9.262
9	0.212	4.259	0.029	0.040	0.026	0.028	0.008	0.445	9.980
10	0.231	4.325	0.030	0.036	0.023	0.032	0.006	0.456	9.807
11	0.199	4.080	0.011	0.009	0.009	0.008	0.002	0.431	10.033
12	0.217	4.342	0.009	0.011	0.005	0.005	0.001	0.434	9.589
13	0.236	4.136	0.060	0.077	0.040	0.060	0.014	0.465	9.890
14	0.204	4.343	0.042	0.057	0.037	0.040	0.006	0.463	9.832
15	0.214	4.949	0.023	0.027	0.021	0.020	0.003	0.465	9.786
16	0.200	4.845	0.012	0.028	0.026	0.013	0.002	0.439	9.748
17	0.191	4.372	0.004	0.004	0.007	0.004	0.000	0.432	9.456
18	0.213	4.894	0.009	0.025	0.016	0.010	0.004	0.442	9.617
19	0.214	4.095	0.048	0.066	0.035	0.041	0.006	0.450	9.776
20	0.211	4.035	0.073	0.057	0.033	0.040	0.005	0.433	9.876
AVG	0.216	4.410	0.034	0.039	0.025	0.027	0.006	0.433	9.784
Std. Errors	0.0037	0.0070	0.0044	0.0054	0.002	0.0033	0.0009	0.0020	0.0050

Figure 13. Facility Queue Times

As seen in the above figure, the engine facility has the longest queue time. The major factor that causes long cycle times is the queue in the engine facility. Note that the average waiting time is around 10 months. In this scenario, the engine facility is a bottleneck in the overhaul maintenance process. Figure 14 shows the waiting times in the engine facility within a 300-month period.

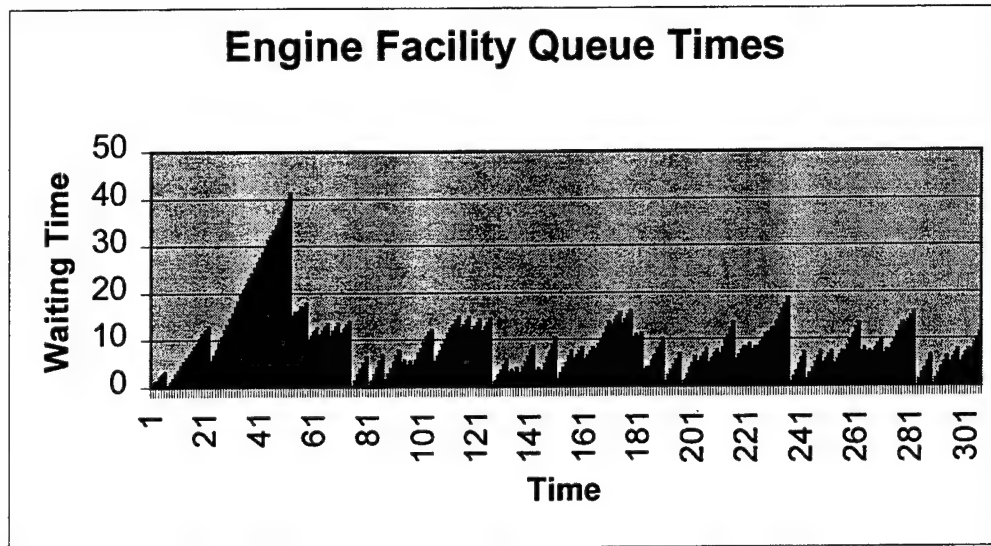


Figure 14. Engine Facility Queue Times

There are two reasons for long queues in the engine facility. One of them is the number of engines per ships to repair. Since each ship has at least two engines, the number of arrivals at the engine facility is larger than number of ships. For example, the engine facility has to repair six engines for a large ship, while the dry dock facility is taking care of one large ship. As seen in Figure 10, number of engines to be repaired in the engine facility is four times higher than number of ships to be repaired in the drydock facility.

The other reason for long queues in the engine facility is that the engine facility has the longest process time in the shipyard. Since we cannot change the number of engines on the ships, attempting to reduce the number of engines through organizational changes would be impossible. The manageable cause of the bottleneck is long process time in the engine facility, this factor is the one that can be addressed to improve productivity.

The gun facility has the second longest queue times within the system for the same reasons as the engine facility queue (i.e., multiple weapons on each ship). The queue times of other facilities are not significant in this system.

Another statistical result from summary report is the facilities' utilization values. The facility utilization values are shown in Figure 15 below.

Replication	Average Utilization Values								
	Electric	Drydock	Anchor	Engine	Paint	Wooden	Navigation	Electronic	Gun
1	0.169	0.211	0.190	0.939	0.116	0.147	0.152	0.144	0.761
2	0.168	0.210	0.185	0.939	0.113	0.155	0.147	0.141	0.760
3	0.173	0.209	0.187	0.939	0.115	0.157	0.156	0.141	0.760
4	0.178	0.200	0.186	0.939	0.114	0.152	0.156	0.140	0.758
5	0.175	0.209	0.191	0.935	0.115	0.148	0.153	0.143	0.761
6	0.170	0.204	0.189	0.939	0.116	0.151	0.154	0.142	0.754
7	0.168	0.204	0.187	0.938	0.113	0.154	0.151	0.142	0.757
8	0.173	0.209	0.188	0.937	0.111	0.154	0.158	0.145	0.762
9	0.172	0.207	0.185	0.939	0.113	0.154	0.153	0.146	0.766
10	0.171	0.209	0.188	0.938	0.111	0.155	0.153	0.143	0.761
11	0.170	0.210	0.185	0.939	0.115	0.155	0.150	0.143	0.750
12	0.169	0.210	0.185	0.936	0.115	0.154	0.147	0.144	0.760
13	0.170	0.207	0.186	0.939	0.114	0.151	0.152	0.148	0.756
14	0.172	0.205	0.188	0.937	0.119	0.150	0.151	0.142	0.760
15	0.169	0.205	0.186	0.936	0.112	0.157	0.152	0.146	0.755
16	0.167	0.205	0.187	0.938	0.117	0.149	0.154	0.143	0.757
17	0.168	0.209	0.185	0.938	0.117	0.150	0.154	0.141	0.760
18	0.172	0.203	0.188	0.936	0.114	0.149	0.153	0.144	0.753
19	0.169	0.204	0.186	0.939	0.118	0.157	0.152	0.142	0.756
20	0.172	0.209	0.184	0.939	0.116	0.149	0.147	0.142	0.760
AVG	0.171	0.207	0.187	0.938	0.115	0.152	0.152	0.143	0.758
Std. Error	0.0005	0.0006	0.0004	0.0002	0.0004	0.0006	0.0006	0.0004	0.0007

Figure 15. Utilization Values

The facilities that have longer queue times become busier than the other facilities. Therefore, facilities with long queues have higher utilization values. Here, the engine

facility has the highest utilization, eighty nine percent. The engine facility is free only eleven percent of the time. The paint facility has the lowest utilization, since it has the shortest queue times.

C. POTENTIAL IMPACTS OF AN INCENTIVE SYSTEM

The current productivity of the shipyards shows that, on average, each type of ship spends five months longer than the standard overhaul time in the shipyards. This delay is created by the long process times. This delay lowers the operational availability of the ships and Naval readiness.

The first potential impact of an incentive system could be decreasing process times. This decrease will lower overhaul cycle times. According to the examples of incentive system implementations given in Chapter IV, some organizations benefit from using group incentive systems or non-monetary incentives. For example, after implementing such an incentive system and non-monetary incentives, the Rock Island Arsenal and the Veterans Affairs Health Care Network improved their productivity levels by 17 and 20 percent, respectively. We can use these figures in our simulation model to estimate the potential improvements if we implement a group incentive system with non-monetary incentives. Decreasing the process time of the engine facility by twenty percent dramatically improves the cycle times of each ship type. Figure 16 shows the results of the simulation model with a twenty- percent shorter process time in the engine facility.

Replication	Average Cycle Times			Operational Availability		
	Large	Medium	Small	Large	Medium	Small
1	11.741	8.101	9.063	0.732	0.771	0.744
2	11.570	7.929	8.943	0.734	0.775	0.746
3	11.856	8.204	9.175	0.730	0.769	0.741
4	11.649	8.044	9.013	0.733	0.772	0.745
5	11.617	8.058	8.483	0.733	0.772	0.756
6	11.650	8.118	8.390	0.733	0.771	0.756
7	11.773	8.161	8.239	0.732	0.770	0.757
8	11.606	8.728	9.057	0.733	0.759	0.744
9	11.899	8.245	9.206	0.727	0.768	0.741
10	11.621	8.001	8.518	0.733	0.773	0.755
11	11.584	8.077	8.111	0.734	0.772	0.760
12	11.602	7.993	9.040	0.733	0.773	0.744
13	11.897	8.216	9.072	0.730	0.769	0.743
14	11.801	8.177	9.104	0.731	0.770	0.743
15	11.361	8.329	7.528	0.736	0.767	0.773
16	11.668	8.083	7.964	0.733	0.772	0.763
17	11.734	8.114	9.112	0.732	0.771	0.743
18	11.618	8.319	9.096	0.734	0.767	0.743
19	11.702	8.089	8.913	0.732	0.772	0.747
20	11.690	8.090	8.198	0.732	0.772	0.758
AVG	11.682	8.154	8.711	0.732	0.770	0.750
Std. Errors	0.0275	0.0370	0.1070	0.0004	0.0007	0.0019

Figure 16. Cycle Times and Operational Availability with Shorter Process Time

As seen in Figure 16, shorter processing time significantly reduces cycle times. With a twenty- percent lower processing time, the cycle times decrease by twenty eight percent for large ships, thirty six percent for medium ships, and twenty nine percent for small ships. When we measure the productivity of the shipyards according to the overhaul cycle times, the potential average improvement in productivity is twenty four percent.

Shorter processing time would also increase operational availability of the ships. The increase in operational availability is eight percent for large and small ships, and ten

percent for medium ships. On average, nine percent more ships will be operational at any time. This increase in operational availability will also increase the Navy's readiness.

The decrease in process times also affects queue times in the facilities. The ships or parts will not wait as long for service as they did previously. The queues and the queue times of the facilities will be shorter.

With a twenty four-percent improvement in productivity, the shipyard will potentially save money. For example, assume that cost of overhaul maintenance is \$15,000 per large ship, \$10,000 per medium ship, and \$5,000 per small ship per month. Shortening the cycle time for each type of ship by twenty four percent, which is approximately five months, will save the shipyard \$75,000 per large ship, \$50,000 per medium ship, and \$25,000 per small ship. When we do the same calculation for all of the ships in the Turkish Navy, the benefit would be extremely high. Compared to this saving, our proposed incentive system cost almost nothing, because it uses non-monetary incentives. In this case, it is very possible that potential benefits of a group incentive system with non-monetary incentives will exceed the cost of this incentive system.

As we reviewed in Chapter IV, some companies saved millions of dollars from implementing incentive system similar to those proposed here. For example, an Amoco Plant saved \$18 million, and American Airlines saved \$50 million. In conclusion, it is worth implement our proposed incentive system at Turkish Naval Shipyards, because they might save similar amounts as those mentioned above.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. IDENTIFICATION OF AN ALTERNATIVE INCENTIVE SYSTEM

The shipyards currently have compensation systems that include incentives such as early promotion, performance awards, special act awards, Navy-wide honorary awards, and invention awards. The current levels of productivity in the shipyards, reviewed in Chapter II and Chapter VI, also offer proof that the current compensation system is not effective. Chapter II addresses the weakness of this compensation system in detail. As such, it is obvious that shipyards need an alternative incentive system that can be implemented to improve productivity within the shipyards.

Chapter III discusses the types of incentive systems currently in use in the public and private sectors. Chapter IV examines the existing barriers to implementing an alternative incentive system. Determining which systems are feasible under the existing constraints can help identify an alternative incentive system. Of the alternative incentive systems and incentives discussed, a group incentive system (including non-monetary incentives), is the most viable recommendation for the Turkish Naval Shipyards.

A group incentive system is recommended for shipyards for two primary reasons. First, group incentive systems are superior to the other incentive systems because:

- Group incentives focus on individual performance found in individual incentive systems.
- Group incentives require less effort to implement and maintain than individual incentive systems.

- Group incentives provide more focus on the individual than organizational incentives.

Group incentive systems are also most easily integrated into the existing work environment and culture in Naval shipyards, which is characterized by a number of established teams at each facility. Therefore, it is easier to implement a group incentive system than the other incentive systems, because group incentives encourage people to work as members of a team and to contribute to the team's performance. The cultural profile of the shipyards' personnel suggests that it is much easier to reward group achievements than individual achievements, since the relationship among the employees does not allow for objectively determining eligibility for awards.

For the regulatory and budgetary reasons previously mentioned, non-monetary incentives are the most viable incentives for shipyards. Non-monetary incentives are personal and flexible, and do not entail great effort and expense. Non-monetary incentives may also have immediate impacts on employee productivity. Possible non-monetary incentives for the shipyards include: (1) opportunities to attend training or courses offsite; (2) additional vacation; and (3) recognition.

Recognition is the best way of using non-monetary incentives. (Nelson, 1996)
Some forms of recognition that can be implemented at the shipyards are listed below:

- Recognition items such as mugs, t-shirts, bags, pencils, calendars, calculators, key chains in the event of individual or group achievement
- Letters of appreciation or a certificate of appreciation
- A Commandant's Bulletin article about an employee's or group's accomplishment

- A handshake from the Commanding Officer of the shipyard at a meeting
- Recognizing efforts at a meeting in the presence of all employees
- Creating a wall of fame with photos of outstanding employees or groups.
- Extend employee's lunch period for a day
- Authorize managers to hand out lunch coupons
- Public acknowledgement when discussing an employee's or group's ideas with other people, peers, or especially higher management.

These recommended recognition forms are listed by priority based on the author's two-year experience at Turkish Naval Shipyards. The top four recommended recognition forms will be reviewed in more detail in the following two paragraphs.

Recognition items and letters of appreciation are likely the most effective forms of recognition, because most employees like to display such items or certificates in their office. Within the current culture, most of the employees feel happy and exited when they are able to show others that management appreciates their success. Since such recognition items and certificates are easy to display, employees mostly prefer these tangible recognition items.

Articles in Commandant's bulletin about an accomplishment or a handshake from the Commanding Officer are also valuable for the employees. When we recognize a group, the group members get prestige. Prestige is a very important and respectful asset among the employees at the shipyards. Employees generally want other employees to be there when they are recognized, or their accomplishments to be known by everybody at the shipyard.

B. INCENTIVE SYSTEM IMPLEMENTATION RECOMMENDATIONS

It is recommended that the shipyards review their mission statements and organizational goals prior to implementing an incentive system. The shipyard management should make sure that every individual clearly understands the shipyard's mission and the goals.

The shipyard management should immediately discontinue the current, superficial compensation system. The feasibility of existing incentives should be examined within a new group incentive system. The feasible incentives can be included in the new group incentive system, and others should be eliminated.

The incentives must be determined prior to implementing a system. Each employee should clearly understand the relationship between performance and the incentive. Additionally, the incentives must reward the desired group behavior.

Prior to implementing a group incentive system, the Turkish Naval Shipyards need to survey their employees to determine what the employees want. Once employee desires are determined, a group incentive system can be aligned with the shipyard's individual and organizational goals.

A group incentive system has the advantage that it can be tested on selected teams to determine its effectiveness prior to implementation on a larger scale. The teams in the engine facility should be used as the test subjects prior to shipyard-wide implementation, as this facility is the primary bottleneck in the overhaul maintenance process.

The managers who are able to nominate groups for an incentive or to give incentives must be empowered to nominate eligible groups for incentives and to give

incentives. These managers should be encouraged to be flexible in implementing the incentive system.

The feedback mechanism during the implementation must collect accurate and timely results. The impacts of the new incentive system on the shipyard's productivity must be reviewed periodically. These results must also be available to every employee. If necessary, changes in incentives should be based on these results.

The shipyard management must consider employee ideas about the incentives and their implementation. The shipyard management must respect the employees' creative efforts to improve the effectiveness of the incentive system.

C. CONCLUDING COMMENTS

An alternative incentive system, when properly implemented and maintained, can improve productivity and quality at the Turkish Naval Shipyards. While there are constraints to incentive system implementation in the current environment, it is possible to implement a new incentive system under these constraints.

This thesis recommends that a group incentive system, which uses non-monetary incentives, be implemented at the Turkish Naval Shipyards.

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